Technology Tutorial Development

for discussion by
Technology Strategy Team
2/3 March 2000

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Objective

- Our objective is to develop a self-study program for the ESE and interested parties
  - to understand the relationships among the science areas, the measurements, the sensors that make the measurements, and the technologies that enable better science
  - use this greater appreciation to facilitate the decision-making process, guide source selection and science policies, and proposal evaluation to do more with less
  - to move at own pace at work or at home

Scope

- A web-based self-study course will cover the fundamentals of both passive and active remote sensing technologies such as electro-optical imagers, infrared sounders, microwave imagers and sounders, environmental sensors, and lidar. The course will include spacecraft technologies, storage and lifetime operations requirements, and systems level considerations. The course will “link” the sensors to ESE science needs.

Research Areas and Measurements

- **Atmosphere**
  - Cloud Properties, Radiative Energy Fluxes, Precipitation, Tropospheric & Stratospheric Chemistry, Aerosol Properties, Atmospheric Temperature & Humidity
- **Solar Radiation**
  - Total Solar Irradiance, Ultraviolet Spectral Irradiance
- **Land**
  - Land Cover & Land Use Change, Vegetation Dynamics, Surface Temperature, Fire Occurrence, Volcanic Effects, Soil Moisture
- **Ocean**
  - Surface Temperature, Phytoplankton & Dissolved Organic Matter, Surface Wind Fields, Ocean Surface Topography
- **Cryosphere**
  - Land Ice, Sea Ice, Snow Cover

Basics for Each Sensor Category

- Electromagnetic Spectrum
- Frequency Allocations
- Wave Propagation, polarization, refraction and penetration
- Microwave dielectric properties of materials
  - water, ice, snow, rocks, soils, vegetation
- Physical properties of the atmosphere
  - absorption, emission, and scattering
- Emission models
  - surfaces, atmospheric layers, scattering albedo
- Antenna Fundamentals

Sensor Categories by Technology

- **Active Cavity Radiometer**
  - TSIM, CERES, SOLSTICE
- **Imaging Detectors**
  - ETM+, LIS, MISR, AVHRR, VIIRS, CrIS
- **Field Detectors**
  - Magnetometer
- **Particle Detectors**
- **Polarimeters**
  - EOSP

Sensor Categories by Technology

- **UV Radiometers**
  - TOMS (UV - Filter), SBUV (UV - Filter), XPS (UV - Filter), OMPS (UV, Vis - Filter), OMI (UV, Vis - Grating), SAGE (UV, Vis - Grating)
- **Microwave/Radio Radiometers**
  - AMSU, HSB, AMSR, Poseidon, JASON, Sea Winds, MLS, CMIS
- **Vis/IR Radiometers**
  - AIRS (Vis, IR - Grating), ASTR (Vis, IR - Filter), GLAS (Active), HIRDLS (IR - Filter), MODIS (Vis, IR- Filter), MOPITT (IR - Filter), TES (IR - FTS), HIS, HIRS, IASI (Vis, IR - FTS), CrIS (Vis, IR - FTS)

System Considerations

- Spacecraft Technology
- Ground Storage Requirements
- Lifetime Operational Requirements
- Ground processing systems
- Systems level considerations - cooling, power, altitude, orbit, RFI, etc.
- Algorithm science and technology
- Sensor Technology & infusion/insertion points
- Continuity of Measurements
- Mass, volume, power requirements

Action/Schedule

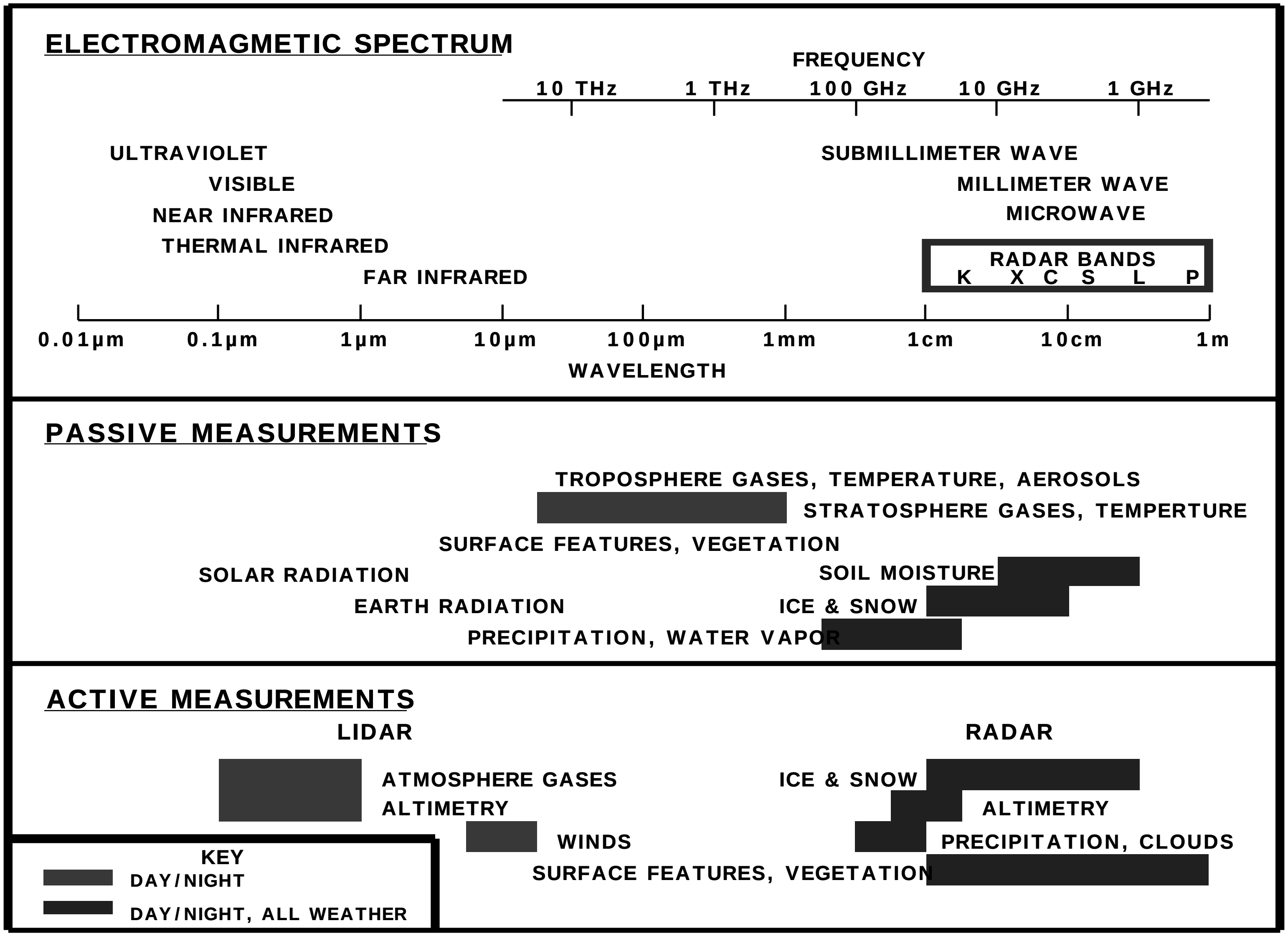
- March 3 - Create Working Group
  - Names submitted by COB 10 March
  - Coordination by Jim Duda/NASA-IPO
- Date - Outline Prepared
- Date -
- Date -
- Date -
- Date - Web Site Available

Backup

Sensor Categories

- Electro-Optical Imagers
  - MODIS, SeaStar, AVHRR, OLS, VIIRS
- Infrared Sounders
  - AIRS, IASI, HIS, HIRS, CrIS
- Microwave Imagers
  - SSM/I, TMI, MIMR, AMSR, CMIS
- Microwave Sounders
  - MSU, AMSU, MHS, ATMS, CMIS
- Ozone Sensors
  - SBUV, TOMS, SAGE, POAM, MLS, GOME, HIRDLS, OMPS
- Space Environmental Sensors
- Lidar

Earth Science Measurement Regimes



GEOSTATIONARY OPTICS

- LEO Orbits Enable Observations Of A Given Location Or Phenomena On A Timescale Of Approximately A Day
  - Corresponds to a Characteristic Spatial Scale of About 0.8 km.
  - Drives Aperture Size to Enable Approximately 0.06 Degree Resolution
- GEO Orbits Enable Observations Of A Given Location Or Phenomena On A Time Scale Of Approximately 10 Minutes
  - Corresponds to a Characteristic Spatial Scale of About 0.3 km.
  - Drives Aperture Size to Enable Approximately 0.0007 Degree Resolution
  - 100x The LEO Characteristic Capability!
- In Addition, GEO Orbits Present A Much More Challenging Thermal Environment For Optics Than LEO Orbits
  - Over Course of 24 Hour Orbit, Optics Range from Pointing Nearly Into the Sun (Midnight) to Pointing Nearly Away From the Sun (Noon)

Characteristic Spatial And Temporal Scales